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SOME OF THE NEWER CONCEPTIONS OF MILK IN ITS RELATION TO HEALTH

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MILK has been regarded from the earliest times as a most important article of food and, although little was known as to its chemical composition previous to the eighteenth century, the ancients attributed many and peculiar hidden virtues to it.

In 1911 ten billion gallons of milk were produced in the United States, one quarter of which was consumed as milk and the remaining three quarters as butter and cheese. Although milk and milk products constitute about 16 per cent. of the average dietary in this country, the average daily consumption of milk per capita is but 0.6 of a pint. The milk of goats and asses has found but little favor on this continent; in Asiatic and European countries, however, it is a common article of diet, particularly goat's milk.

The chemical composition of milk is such as to make it a perfect food for infants, and at the same time an ideal culture medium for almost all kinds of bacteria. Sanitarians have in recent years impressed upon the minds of consumers the great dangers arising from the use of unclean and impure milk, and justly so; but in the slow and gradual readjustment of the milk production problem the intrinsic value of milk has often been lost sight of, and in fact prejudice has too often superseded what once was fondness for this product. As numerous publications on this subject, both popular and scientific, are appearing almost constantly, little attention will be given in this paper to the sanitary phase of milk production. It is to be understood, however, that in the discussion of the value of milk as a food pure and wholesome milk alone is given consideration.

There is a widely prevalent notion that the average amount of meat consumption per capita in this country is far beyond what it should be, and there are many who object to meat in any form or amount. These objections are based on the following contentions: first, that the high protein content of meat

subjects the digestive and excretory organs to a heavy burden; second, that as real animal food the consumption of meat necessitates the destruction of the animal itself, and finally that the cost as a rule is out of all proportion to the value received, especially in times of scarcity. It is not within the province of this paper to express a conviction as to whether meat is a necessary or even desirable article of diet. Indeed, the arguments offered both for and against meat and meat products are such as to render a final judgment most difficult.

On the other hand, milk is without doubt the most important of all foods, and must be regarded as an absolute necessity in the early life of all mammalian species, in spite of the fact that here and there proprietary infant foods have been employed with at least some measure of success.

The value of mother's milk to the young infant is too well known to require much comment. However, the growing tendency to substitute artificial for breast feeding is an indication that the subject of infant feeding is not taken as seriously as it deserves. Mother's milk is superior to any and all substitutes, as abundant statistical evidence shows. Furthermore, it has always been the only natural food for the very young.

Next in importance to mother's milk is cow's milk. While the protein content of the latter is much greater than that of mother's milk, methods of modifying it by dilution with water and the addition of milk sugar and cream have in recent years done much to enhance the value of cow's milk in infant feeding, and in fact so successful has this practice become that in the opinion of many physicians and dietitians it is rated as being almost equal in nutritive value to mother's milk.

It is the purpose of this paper to impress upon its readers the importance of milk as a daily article of diet, not only for the very young, but for children of all ages and for adults. If the true value of milk as a stimulator of growth and vigor throughout the developmental period were known and fully appreciated, the number of underdeveloped and anemic children would be greatly reduced. Too often milk feeding for the infant is regarded merely as a necessity, because it is the only food that is tolerated by the easily deranged digestive organs, as experience has long shown. When an age is attained at which other foods are apparently borne as well as milk little effort is made to continue milk feeding, especially if there is any indifference or reluctance on the part of the child.

It is a well-recognized fact that, while the chemical com-

position and physical properties of mother's milk and modified cow's milk are such as to render them an ideal food for young infants, the percentage of solids, particularly sugar, protein and fat, is too small to constitute a complete diet for older children and for adults. Hence, milk must be considered as only a part of a dietary regime after early infancy, except for the sick and convalescent. The amount and kind of other foods required vary with the individual and in a large measure with his or her occupation. For example, a man at hard labor would be required to consume large quantities of milk, in order to obtain sufficient nourishment as compared with a person living a very quiet and sedentary life. However, the benefit derived from the consumption of milk is in all probability not proportionate to the amount of milk taken daily.

One of the greatest modern exponents of the use of milk as a part of the daily diet was Metchnikoff, who by his public utterances and numerous publications stimulated new interest in this subject. Metchnikoff's observations and theories pertained only to so-called "sour milk" and "sour-milk products," and although opinions may differ as to whether or not his explanations of the health-giving properties of sour milk are based upon sound logic, his conclusions must, in a measure at least be accepted. A review of some of Metchnikoff's observations may be of particular interest here. The following excerpts are taken from his most fascinating book, "The Prolongation of Life" (G. P. Putnam's Sons, New York, 1907, translated).

In early biblical times the use of both sweet and sour milk is recorded. From the remotest antiquity a food known as "Leben raib," which is a sour milk prepared from the milk of buffaloes, kine or goats, has been employed in Egypt. A similar preparation known as "yahourt" has long been familiar to the people of the Balkan States. In Algiers the natives use a kind of "Leben" which differs somewhat from the Egyptian product. Soured milk is consumed in great quantities in Russia in two forms, namely "prostokwacha" which is a spontaneously soured and coagulated raw milk, and "varanetz" which is a product obtained by the souring of boiled milk with yeast.

Milk constitutes the chief food for many of the natives of tropical Africa. As in the other countries mentioned, the milk is consumed as a curdled, soured product. Meat is eaten only on rare occasions.

Koumiss is the well-known national beverage of nomadic

tribes in Asiatic Russia. It is prepared from mare's milk, while kephir, which is the native drink of the Caucasus, is the fermented product of cow's milk. Both koumiss and kephir contain, besides acid-producing bacteria, yeasts which cause alcoholic fermentation, the alcohol content of the former being at times as much as one per cent. Matzoon is a milk in which lactic acid fermentation is interrupted at a certain point. It is often tolerated better by irritable stomachs than ordinary milk, koumiss or kephir. It is a highly esteemed and universal beverage of the Armenians, and may be prepared easily by the addition of a small amount of matzoon stock to boiled milk that has been cooled to 100° F.

Coincident with the general use of soured milk in certain countries is the fact that many of the inhabitants live to be very old. This is particularly true in Bulgaria, where yahourth is the staple food. Many of the centenarians live chiefly on the milk diet. For example, Marie Priou, who died at the age of 158 years, is stated to have lived during the last ten years of her life entirely on cheese and goat's milk.

A certain laborer of Verdun in France who died at the age of 111 years ate nothing but unleavened bread and skimmed milk. Another French centenarian who attained 110 years lived on bread and milk food alone. Thense Abalva, a native of the Caucasus, who is at least 150 years old, subsists entirely on barley bread and butter milk. Another apparently well-authenticated example is that of an American eighty-four years old who owes his health to the curdled milk which he has taken for the last 40 years.

While there are comparatively many centenarians on the Balkan Peninsula, in Persia, Arabia, in the Caucasus, and in other countries where sour milk is the chief article of diet, or at least where it is consumed regularly in large quantities, there are relatively few persons who attain this age in the countries where sour milk consumption has not become a national custom.

According to Metchnikoff, sour milk is of great merit because of the lactic acid and of the acid-producing bacteria which it contains in enormous numbers. The ingestion of sour milk has a direct influence on the bacterial processes which take place in the digestive tract, particularly in the large intestine. A diet containing much albuminous food is conducive to marked putrefactive changes in the large intestine. Sour milk or the acid-producing bacteria decrease or prevent this putrefaction, which is the result of ordinary microorganisms that are

normally present in the intestine. In other words, intestinal putrefaction, which is caused by certain so-called "putrefactive" organisms, is a process which is of common occurrence in man, especially on an ordinary mixed diet. This process is in itself harmful on account of the injurious nitrogenous bacterial products that are constantly formed and absorbed from the intestine, this harmful influence being what is commonly called "auto-intoxication."

According to Metchnikoff these putrefactive products, although not strongly toxic in small amounts or when administered for only short periods, work permanent injury to the body when they are being absorbed constantly for months and years. In fact so profound is this baleful influence that it may be considered as one of the important causes of permanent hardening of the arteries, or arteriosclerosis, and indeed premature old age. Acid is one of the agencies which prevents these putrefactive changes in the intestine. It controls the bacterial activities in such a way that only such organisms as are harmless are permitted to increase in appreciable numbers. More recently Metchnikoff has advocated also the use of acid-producing bacteria for the same purpose, claiming that when they are taken into the digestive tract they become acclimated in the intestine and in their continued development suppress the putrefactive bacteria. Many different brands of these acid-producing bacteria are being produced and sold in the form of powders, capsules, etc. The active principle in all of them, however, is the organism known as *Bacillus bulgaricus*, to which in particular most of the sour-milk products of the Balkan and other states owe their peculiar properties.

Bacillus bulgaricus is a unique organism in more respects than one. In a medium containing grape or milk sugar it exerts powerful fermentative properties which results in the production of large amounts of acids, but no gases. Ordinary milk is a particularly favorable medium for this organism, and the acidity produced may reach as high as 2.5 to 3 per cent. This is not at all surprising, as milk contains from four to five per cent. of milk sugar. Very few organisms are able to develop or even live in such an acid medium, and this is especially true of the putrefiers.

Metchnikoff's views have met with no inconsiderable amount of opposition. On the other hand, they have in the main been accepted by many, as is evidenced by the large output of different Bulgaria products sold usually in the concentrated dry form as tablets or powders. These products in many

instances are claimed to possess great remedial properties, as, for instance, in toxic diarrheas, constipation, intestinal putrefaction, arteriosclerosis, and even rheumatism, intestinal tuberculosis and typhoid fever. They have been advocated and used for sprays in diphtheria and other mouth and throat infections. The preparation of sour milk with the aid of these tablets or powders has also become a very common practice in recent years, and there can be no doubt but that in many instances the use of sour milk so prepared has been attended with success.

That the value of these *Bacillus bulgaricus* products has been grossly exaggerated can hardly be questioned, and particularly in so far as the remedial properties of the commercial powders and tablets are concerned. On the other hand, the consumption of sour milk, as advocated by Metchnikoff and his followers, has much to commend it. The value of the sour milk does not lie in the acids or the acid-producing bacteria, however, as will be shown in this paper, but in milk as such, irrespective of the character of the milk as to whether it is sweet, sour, whole, skimmed, raw or pasteurized milk.

In 1892 Rovighi showed that a kephir diet caused a great reduction in the ethereal sulphates (intestinal putrefaction products) in the urine, and of indol in the intestine. He believed that acids played an important rôle in suppressing intestinal putrefaction, but could not substantiate this by practical experiment. In the same year Winternitz demonstrated that milk strongly inhibits putrefaction, and held that this was due to the lactose, and not to the acids resulting from its decomposition by bacteria. The following year Schmits brought about a marked reduction in intestinal putrefaction products by feeding lactose. These observations have been repeatedly verified by other investigators.

The intestinal contents of the new-born infant are free from bacteria and other microscopic organisms. Very soon after birth, however, bacteria make their appearance and in the course of but relatively few hours become very abundant. The nature of these microorganisms is determined by the food of the infant, as was shown by Tissier and others. In the normal breast-fed child an organism first observed and described by this writer, and known as *Bacillus bifidus*, is present to the exclusion of all other forms. This organism readily attacks milk sugar without gas production, but has no putrefactive properties; in other words, it does not decompose albuminous substances with the formation of injurious products.

A change from breast- to bottle-feeding is accompanied by a change in the character of the intestinal flora. The simplified type is transformed into a mixed flora in which another organism, *Bacillus acidophilus* of Moro, assumes much prominence. When the diet becomes more varied by the addition of other foods, as, for example, egg and bread, the intestinal flora becomes still more complex and gradually assumes the character of that of the adult.

The bacterial flora of the intestine of man and animal may in a very large measure be determined by the diet. We have repeatedly shown that the bacterial contents of the intestine of the white rat may be transformed from the mixed to a simplified flora by the addition of milk to the regular diet. In the course of one to three days a flora is established which resembles that of an infant subsisting entirely on milk. When milk sugar is fed along with the milk, or alone in sufficient amount, the typical *bifidus* flora of the breast-fed child is obtained. The same transformation may be brought in the intestine of man, though relatively larger amounts of milk and of milk sugar are required. Torrey demonstrated that the feeding of a high caloric diet (milk and milk sugar) to typhoid patients tended to reduce the putrefying types of bacteria and to encourage the so-called "acidophilic" organisms which characterize the intestinal flora of infants subsisting entirely on milk.

The favorable influence of milk on the bacteria of the intestine is due largely to the lactose or milk sugar in the milk, which at times contains as much as six per cent. of the carbohydrate. The harmless and perhaps even beneficial bacteria of the *Bacillus bifidus* type readily attack milk sugar, and in the presence of this sugar find their optimum environment in the intestine, and develop so readily as to suppress or crowd out the harmful or putrefactive forms which find their most favorable cultural conditions in a medium rich in nitrogenous matter and poor in carbohydrate.

The preponderance of the sugar-loving type is not due to the acids that are produced in the decomposition of the sugars, nor can the reduction or disappearance of the putrefactive forms be ascribed to the presence of free acids in the intestine, for, except when they are introduced into the intestine in large amounts, acids rapidly disappear through absorption by the intestinal wall or by neutralization. This has been shown repeatedly. Metchnikoff's contention that the use of sour milk and milk-souring bacteria is of benefit to the consumer because of the action of the acids that are thereby introduced into the

intestine is not supported by direct observation. The suppression of putrefactive processes is brought about by influences other than acids.

It has likewise been shown again and again that the ingestion of even very large numbers of *Bacillus bulgaricus* with or without milk does not lead to an implantation and acclimatization of this organism in the intestine. This bacterium, which is of such wide distribution in nature, and especially in different kinds of sour milk, is unable under any and all conditions to establish itself in the intestine of man or animal. However, an organism (*Bacillus acidophilus*) which in many respects is closely allied to *Bacillus bulgaricus* is a common inhabitant of the intestine. Like *Bacillus bifidus*, which it closely resembles in appearance and physiological properties, *Bacillus acidophilus* is comparatively rare in the intestine during an ordinary mixed diet or one rich in protein. The addition of milk or of milk sugar to the diet encourages the development of this organism in the intestine, and at times to such an extent that all other forms are apparently excluded. This bacterium has often been mistaken for *Bacillus bulgaricus*.

That the so-called *Bacillus acidophilus* is not the same as the other may be shown readily by feeding milk which has been sterilized. The same transformation takes place in the intestine as when unheated sour milk is consumed. The ingestion of milk in any form, sweet, sour, raw or sterilized, leads to this same result. On the other hand, the feeding of even very large numbers of *Bacillus bulgaricus* in water, without milk or lactose, does not result in the implantation of the ingested organism, and the intestinal flora remains unchanged. It may be said, therefore, that diet is an important factor in determining the character of the intestinal flora, and that foreign bacteria find it difficult and as a rule impossible to establish themselves in the intestine. Bacteria which are of the strictly disease-producing type are, of course, not to be included in this category.

Aside from the significant fact that milk when taken in sufficient amount regulates the biochemical changes which take place in the lumen of the intestine, milk as such constitutes a most important article of diet. The value of milk as a food lies not only in its peculiar composition, that is in the proteins, fat, sugar, inorganic salts and other well-known ingredients, but also in certain demonstrable but as yet vaguely-defined substances known as "vitamins" or "accessories." These vitamins belong to a group of agents which are widely distributed

in nature, and which are now regarded as an essential factor in diet. Let us next consider some of the evidence which supports the assertion that milk possesses unique dietary properties.

Hopkins clearly demonstrated that the feeding of very small quantities of milk to rats which had been subsisting on a diet that was not conducive to normal growth brought about a rapid gain in the weight of the animals. Osborne and Mendel in their valuable experiments on the growth of animals have for several years been employing so-called "protein-free milk" as an indispensable ingredient of their basic diet to which certain isolated food substances (proteins, amino acids, etc.) are added. They state that "no artificial imitation of this natural mixture (milk from which all protein had been removed) has been devised to replace it satisfactorily for considerable periods of time." The weight and health of adult rats has been maintained for many months on a ration consisting of protein, starch, sugar, protein-free milk and lard. Young animals kept on this mixture decline after a definite period. If butter fat is substituted for the lard, however, growth is resumed. Hence, they consider the fat as one of the important food substances in milk. The fat is in all probability of much importance on account of the vitamins which it holds, and which are fat-soluble, as contrasted with the water-soluble accessories present in the protein-free milk. Ordinary skim milk contains both the fat-soluble and water-soluble accessories.

Numerous milk-feeding experiments have been conducted on young animals of different species, but few have been of much scientific value, owing to incomplete data and to a lack of adequate control of the experiments. The following investigation is one in which the writer was for several years engaged, and in which the results were a source of surprise even to those who were most intimately associated with the experiments.

THE INFLUENCE OF MILK ON GROWTH AND MORTALITY

Numerous experiments were conducted on young chicks. When one to two days old the chicks were taken from the incubators, divided into uniform groups, usually six, each group containing from 25 to 60 chicks. Half of the lots, for example 1, 3 and 5, were supplied with milk in a shallow galvanized stew pan covered with a meshed wire, while the remaining lots, 2, 4 and 6, received no milk. Both the general groups of

chicks were constantly provisioned with a standard chick feed and dry mash. The milk was kept before the milk-fed chicks constantly. It was supplied as a rule as skimmed milk, rarely as whole. In some of the experiments sweet milk was employed, in others naturally soured, and in still others milk which had been soured by the *Bulgaricus bacillus* of Metchnikoff. In the preparation of the *Bulgaricus* product the milk was sterilized by live steam under pressure. Hence, both raw and sterilized milk was used in large amounts. Over five thousand chicks were employed in this investigation. The duration of the individual experiments was six to eight weeks.

In all of the experiments the milk-fed chicks were larger and in every respect appeared stronger and more vigorous than the corresponding control lots which received no milk. In a few instances the difference in the average weight of the two lots was almost 100 per cent. Furthermore, the combs of the milk-fed groups were redder, and the legs decidedly stronger, than those of the other lots. In one particular experiment, which was allowed to continue longer than the others, a marked difference was noted in the ages at which the males exhibited crowing propensities.

TABLE SHOWING THE INFLUENCE OF SOUR MILK FEEDING ON GROWTH
(Combined results with 1,498 chicks)

Number of Chicks	Gains per Chick at Completion of Experiments		
	Fed Sour Milk	No Milk	Difference
(1) 890.....	0.7 pound	0.43 pound	0.37 pound or 38.5 per cent.
(2) 608.....	0.79 "	0.46 "	0.33 " " 41.8 " "

That the growth-stimulating properties of milk are not confined to sour milk is clearly shown in the following summary of results on 375 chicks:

Combined averages:

	Gains per chick
Fed sour milk	0.48 pound per chick
Fed sweet milk	0.44 pound per chick
Given no milk	0.39 pound per chick

The results obtained with naturally soured and with *Bulgaricus* milk were practically the same, hence no definite figures are presented here. It should be said, however, that a slight preference was shown for the naturally soured milk, as compared with the sweet and with the *Bulgaricus* product.

In the chick-feeding experiments milk exerted a pronounced influence on mortality, no matter whether sweet, naturally soured or *Bulgaricus* milk was supplied. The following figures give the combined results obtained in eight different experiments with 1,125 chicks.

TABULATED RESULTS SHOWING THE INFLUENCE OF SOUR AND OF SWEET MILK ON MORTALITY

Sour Milk		Sweet Milk		Without Milk	
Number of Chicks	Deaths	Number of Chicks	Deaths	Number of Chicks	Deaths
375	65, or 17.3%	375.....	61, or 16.3%	375.....	114, or 30.4%

In two experiments not included in the above figures there was no mortality among the milk-fed chicks, while the loss in the control pens receiving no milk was 10 and 12 per cent.

The favorable influence of milk here shown can not be attributed merely to a regulation of the character of the intestinal flora, but is to be explained in a large measure on the basis of health and vigor production through the growth-producing and stimulating properties of the milk. Growth is a normal process in which metabolic activities are at their height and in which the body cells and tissues are printed to meet the requirements placed upon them. Resistance to inimical influences is stimulated and health is conserved.

Milk contains two important nitrogenous food substances, namely, casein and lactalbumin. Of these two proteins the lactalbumin is the more important in supplying the necessary material for growth and body maintenance, according to the researches of Osborne and Mendel. This is due to the fact that it contains certain chemical groups (amino acids of peculiar composition, as for example lysin) within its molecule which are not present in the casein. Whatever deficiency there is in these substances is more than counterbalanced, however, by the amount of casein present in milk (3 per cent.) as compared with the lactalbumin (0.5 per cent.). Osborne and Mendel found in their feeding experiments with white rats that to produce the same gain in body weight 50 per cent. more casein than lactalbumin was required.

The milk sugar (5 per cent.) and fat (3.5–5 per cent.) present in cow's milk also add greatly to the fuel value; furthermore, the various inorganic substances, particularly calcium, sodium and potassium salts, and the phosphates can not

be ignored. While all of these valuable constituents contribute their great share in making milk the most important of all foods, we must seek further for a full explanation of its real merits. We turn naturally to the so-called "vitamins," to which reference has already been made.

There are present in milk "vitamins" or "food accessories" of two orders. The one is fat-soluble and is therefore bound up in the butter fat. This agent is closely akin to the vitamin of egg yolk and of cod-liver oil. The other is water-soluble, and is present in milk from which the fat has been to a large extent or entirely removed. While opinion has differed as to the heat tolerance of these accessories, there is no doubt that both the fat- and the water-soluble vitamins withstand the heat of ordinary pasteurization, and that they are not completely destroyed even in the process of boiling for as short a period as 10 to 15 minutes. These facts are of much significance, since they have a direct bearing on the question of the relative food value of raw and pasteurized milk. Food accessories or vitamins are now regarded as being absolutely necessary in an efficient diet. Nutritional diseases like scurvy and beri-beri are known to be due to the continued and exclusive use of a diet, as, for example, canned foods and polished rice, from which the vitamins have been lost by excessive heating or the removal of certain parts of the food, as in the polishing of rice.

Considerable effort has been made in recent years to overcome the prejudice existing in the minds of most Americans against pasteurized or boiled milk. No one has done more to convince physicians and laymen that heating does not alter the food value of milk, and that it even improves the quality of milk which is not of a high standard from the standpoint of real sanitation, than Janet E. Lane-Claypon, who has devoted years to this problem. This author's recent book on "Milk and its Hygienic Relations" (Longmans, Green and Co., New York) presents an excellent résumé of the subject of milk in its various phases, and particularly the relative merits of heated and unheated milk. While milk in its relation to infant feeding is the underlying theme throughout the book, the data and discussions on the influence of heat may be applied as well in any movement to stimulate a more general use of milk in its various forms and for persons of all ages.

The time has come when raw milk from tuberculous cows must be regarded as a useless commodity. Such milk is used, however, by thousands of consumers daily, for a large amount of market milk to-day may be found by correct methods to con-

tain the bacillus of tuberculosis. The only real safeguard against possible danger from infected milk is proper heating.

Bang of Copenhagen has adopted and successfully carried out a system of rearing calves which come from tuberculous mothers on milk which has been boiled. The calves are taken away from the mother very soon after birth, and brought up on the heated milk on so-called "calf farms." These calves remain free from tuberculosis, and hence become a valuable addition to the newly selected adult herd, which should remain tubercle-bacillus-free. Similar methods have been followed in this and other countries, not only for the purpose of eliminating tuberculosis from a herd, but also to protect the calves against diseases like "scours" and contagious abortion. Professor V. A. Moore has strongly advocated the feeding of boiled milk to calves, though in one paper he states that a preliminary feeding with raw milk may be advisable.

The following facts are, to a large extent, taken from Miss Lane-Claypon's book: Finkelstein in a large number of observations on children having digestive disturbances concludes that "no definite distinction between the results obtained by feeding upon raw and boiled milk respectively could be detected." "Plantenga treated children with digestive troubles with both raw and boiled milk, and was unable to find any evidence of the superiority of either method of feeding."

In the important investigation of Park and Holt the results were much more favorable from the standpoint of the pasteurized than the raw milk. "Of 51 children who were fed on raw milk, 13 had to be transferred before the end of the period of observation to pasteurized." "Hohlfield published 8 cases of children suffering from various stages of malnutrition who were fed for the most part upon raw milk; some, however, received raw milk alternately with boiled milk." Numerous additional cases might be cited here in which heated milk possessed the same nutritional properties as the raw. It should be stated that the results which favor the heated milk may have been due to a slight extent at least to the bacteria and their products which were present and continued to be harmful in the raw milk.

Pasteurization of cow's milk is rapidly assuming more and more importance in this country. This is due largely to the growing recognition of the possible dangers which may lurk in milk which has not been produced and handled under the most sanitary conditions. It may be explained also on the ground that commercial pasteurizers are becoming more effi-

cient and reliable. Of these pasteurizers two stand out conspicuously as having special merit, the so-called "holding device" in which the milk is held for 20 to 30 minutes at 145 to 150° F., and the device by which the milk is heated at the pasteurization temperature in the package or bottle in which it is delivered. The last-named method has the distinct advantage that the milk can not become re-contaminated after the heating, except by the consumer himself. Pasteurization by this method is one of the best safeguards against milk-borne tuberculosis, typhoid fever, dysentery, septic sore throat and diphtheria. While certified and other high grades of milk are much less apt to contain disease microorganisms than the ordinary market milk, they can not be considered absolutely safe simply because they were produced under sanitary conditions, for there is always a chance of infection from an unrecognized tuberculous cow or from a human carrier.

The use of milk as a daily article of diet can not be too strongly advocated. It matters little whether it is whole, skim, pasteurized or raw, aside from the element of possible danger from harmful bacteria. Nor can too much be said of the nutritional value of cheeses which, we are told, are among the most valuable of our concentrated foods, and which, contrary to popular opinion, are well borne by the digestive and related organs, provided they are well masticated or prepared in a finely divided state before they are served as food.

Skim milk has always been regarded in this country as an almost useless commodity, and many thousands of gallons have been poured daily into the drainpipe. Quite recently, however, the feeding of skim milk to farm animals, particularly young swine and poultry, has fortunately become a general practise. But as food for man it has been not merely ignored, but shunned. This is made all the more apparent by the legal regulations which, because they require the conspicuous labeling of skim milk that is offered for sale, have tended to discourage the sale of this product. Skim milk contains almost the same amount of nutriment and so-called "accessories" as whole milk, the only difference being in the quantity of fat which by the skimming is reduced three to four per cent. All of the sugar, casein and lactalbumin, as well as the significant vitamins, inorganic salts and a small amount of fat are retained in the product commonly termed skim milk.

Skim milk should find its way into every home, at least for cooking purposes, and its use in cooking and baking should be made a very common practise. The present-day agitation to

bring about a more general employment of skim milk in the home should receive universal approbation, from the standpoint of both health and economy.

Many persons have little or no tolerance for sweet milk, while sour or buttermilk is well borne. For such individuals the sour milk obtained by the use of *Bulgaricus bacillus* tablets or powders will often be found to be a good substitute for sweet milk. These bacillus tablets or powders may be purchased at any reputable drug store, being prepared by a number of large manufacturing houses in this country. Skim milk or milk from which part of the cream has been removed is heated until it boils. It is then allowed to cool to about 105° F., and inoculated with a sufficient amount of the *Bulgaricus* preparation (two or three ordinary tablets for each quart of milk). The tablets or powders should be mashed and mixed with a small portion of the milk before all of the latter is treated. After thorough agitation the milk is kept in a moderately warm place (on the back of the range or in a special incubator or fireless cooker). Four to five hours at 105° F. are usually sufficient for the necessary souring, and great care should be taken to prevent the milk from becoming too acid. When the incubation is completed the product should be placed in the refrigerator and constantly kept at a low temperature, to preserve the correct flavor. For preparing a new product from day to day some of the preceding fermented milk may be used instead of the commercial preparation.

A dish that is highly relished in parts of Europe is a bowl or crock of naturally soured milk from which the cream has been removed and over the surface of which broken bits of bread or toast are distributed so as to form a complete layer. This layer is usually sweetened with table sugar, and in many instances cinnamon and other spices are employed to heighten the flavor. *Bulgaricus*-soured milk is also put to a similar use by many thousands of persons who subsist in a large measure on a milk and bread diet.

In concluding this paper the writer wishes again to emphasize the nutritional value of milk as milk, irrespective of whether it is whole, skim, sweet or sour milk. On account of the highly important known food substances which are present, namely fat, sugar, casein, lactalbumin and certain inorganic salts, and of the as yet poorly understood vitamins or accessories, milk has a most stimulating influence on bodily growth and strength, and therefore is an important factor in regulating and preserving health.

Pasteurizing or boiling for a short period does not destroy the nutritional value, as numerous experiments have without doubt demonstrated, although physicians have from time to time claimed that heated milk as a diet for small children is conducive to scurvy. Where any doubt concerning this point has existed the feeding of small amounts of orange juice has been sufficient to allay fear.

Sour milk is not beneficial on account of the acid or acid-producing bacteria which it contains, but, like sweet milk, tends to encourage the development of an intestinal flora from which the putrefying bacteria are greatly reduced or absent. This property milk seems to owe to the sugar which it contains. Skim milk exerts the same influence.